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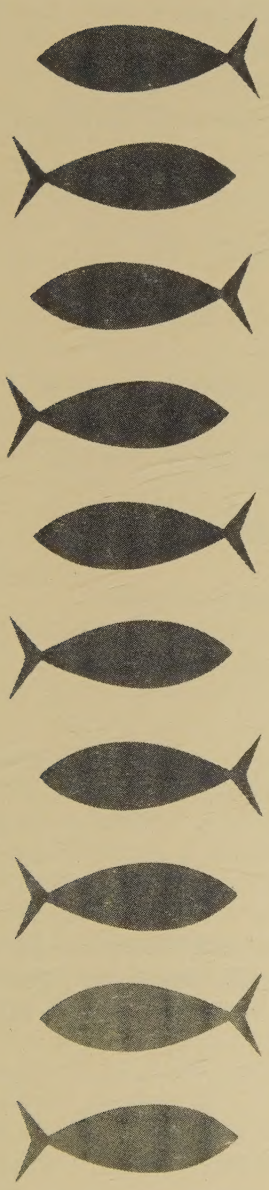

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SOUTHWEST FISHERIES SCIENCE CENTER

CENTER ADMINISTRATION- La Jolla, California

Science and Research Director, SWR ..... *Izadore Barrett*
Deputy Director ..... *Richard A. Neal*
Planning Officer ..... *David J. Mackett*
Information Technology Services ..... *Dorothy Roll*
Executive Officer ..... *Benjamin F. Remington*

LABORATORIES & DIVISIONS

Antarctic Ecosystem Research Group, Chief ..... *Rennie Holt*
La Jolla, California
Coastal Fisheries Resources Division, Chief ..... *John R. Hunter*
La Jolla, California
Fishery-Marine Mammal Interactions Division, Chief ..... *Douglas P. DeMaster*
La Jolla, California
Honolulu Laboratory, Director ..... *George W. Boehlert*
Honolulu, Hawaii
Pelagic Fisheries Resources Division, Chief ..... *Gary T. Sakagawa*
La Jolla, California
Pacific Fisheries Environmental Group, Chief ..... *Andrew Bakun*
Monterey, California
Tiburon Laboratory, Director ..... *Alec MacCall*
Tiburon, California

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ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

Third Meeting of the Working Group on Krill Held in Yalta

The third meeting of the Working Group on Krill (WG-Krill) was held at the Oreanda Hotel in Yalta, USSR, July 22-30, 1991. The WG-Krill was established by the Scientific Committee of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), whose members nominate specialists to participate in the annual meetings of the Working Group. The U.S. delegation consisted of Rennie Holt and Roger Hewitt (SWFSC), and John Bengtson (National Marine Mammal Laboratory-NMML). Other national delegations were from Australia, Brazil, Chile, Federal Republic of Germany, Italy, Japan, Netherlands, Norway, Poland, Republic of Korea, South Africa, Spain, Sweden, United Kingdom, and USSR.

The main objectives of the meeting were to review krill fishing activities within the Convention area, and to refine estimates of potential yield and biomass. In addition, the Scientific Committee and WG-Krill were asked to provide best estimates for precautionary catch limits on krill in various statistical subareas of the Convention area, and to identify various options on which such limits could be based.

Two papers presented at the meeting by Poland and Chile, along with comments from other members, established a preliminary catch figure for krill for the 1990-91 season at 268,328 tons. The Chilean delegation indicated that they may increase their fishing effort slightly in the future, while USSR and Poland indicated that they have no immediate plans for any increases. It was also reported that Japanese and Korean krill fishing may decline, depending on market forces. Australia reported that an application by an Australian company to harvest 80,000 tons of krill annually, is currently being considered.

The USSR presented a paper of one scientific observer's data collected aboard a Soviet commercial fishing vessel. The WG-Krill encouraged members to expand observer programs, as biological and other data from the krill fishery are very important to the work of the Group.

Several papers were presented at the meeting in consideration of whether the 1990-91 season was a poor fishing year for krill in any of the Convention's subareas. Information was presented which indicated that krill were late in appearing in the Antarctic Peninsula and South Georgia areas; they were delayed at least 2 weeks, appearing in early February. It was also reported by the United Kingdom that a fish stock assessment survey around South Georgia showed that only 20% of *Champsocephalus gunnari* stomachs contained krill, in comparison to an average of 60% from earlier years. This drop would seem to indicate a scarcity of krill in this region during January 1990-91.

In order to estimate the biomass of krill, it is vital that krill acoustic target strength be defined. In this regard, Roger Hewitt convened a sub-group to discuss papers and informal communications on the topic. In particular, Hewitt presented a paper he co-authored with David Demer that has been accepted by *Nature*, that provides a distribution of *in situ* measurements of individual krill target strengths. The distribution was broader than that which would be expected from a consideration of the size frequency of the krill sampled at the same time using an Isaacs Kidd Midwater Trawl (IKMT) net. The spread is likely due to variations in animal orientation and shape, and to multiple targets being erroneously identified as single animals.

In developing approaches to managing the krill fishery, the WG-Krill suggested the following four concepts: 1) endeavor to keep krill biomass at a level higher than might be desirable if only single-species harvesting considerations were of concern; 2) base management actions on the lowest biomass that might occur over a future period, rather than the mean biomass; 3) ensure that any reduction of food to predators which may arise because of krill harvesting is not such that land-breeding predators with restricted foraging ranges are disproportionately affected in comparison with predators present in pelagic habitats; and 4) examine the level of krill abundance that would be sufficient to meet the reasonable requirements of krill predators.

The WG-Krill considered several possible approaches to managing the fishery. The Group considered that predictive management, which incorporates the likely population response to harvest pressure, would be desirable in the short term. However, it agreed that developing a feedback procedure for adjusting the predictive model for krill should be a long-term goal.

Precautionary limits on krill catches were discussed in great detail in the interest of preventing unregulated expansion of the fishery while the information available for predicting potential yield is very limited. It was stressed that any such measures would be short term and would need regular review. Two alternative bases for specifying precautionary limits were considered for Area 48 (South Atlantic sector of the Southern Ocean) of the Convention.

Using a model provided at the meeting, the best estimate of a precautionary catch limit for krill in Area 48 was 1.5 million tons. Both the Japanese and Soviet delegations entered minority opinions concerning the acceptability of the number (1.5 million tons) as a "Total Allowable Catch" (TAC). The US delegation expressed reservations about the number because data used to calculate it are not very precise. In addition, the US noted that much of the catch is caught near land-breeding predator colonies, and therefore, the yield estimate may be too large. Based on these reservations, the WG-Krill did not recommend the number as a TAC. (J. Rosenberg, FTS 893-5600)

Sixth Meeting of the Working Group for the CEMP

The sixth meeting of the Working Group for the CCAMLR Ecosystem Monitoring Program (WG-CEMP) was held at the Instituto Español de Oceanografía, Santa Cruz de Tenerife, Spain, August 5-13, 1991. The CEMP endeavors to detect significant changes in key components of the Southern Ocean ecosystem and to distinguish between changes due to commercial harvesting and those due to natural causes. The meeting was chaired by the Convener, John Bengtson. The U.S. delegation consisted of Wayne Trivelpiece, Polly Penhale (NSF), Rennie Holt (SWFSC), and Peter Boveng (NMML). Other national delegations were from Australia, Italy, Japan, Norway, Republic of Korea, Spain, Sweden, United Kingdom, USSR.

Because it would be impractical to attempt to monitor all of the Southern Ocean ecosystem, members of CEMP have agreed to monitor certain key species and parameters. These species and parameters have been identified as ones likely to be particularly sensitive to changes in food availability. The food of greatest interest to CEMP is krill (*Euphausia superba*), both because it is the major prey for most of the critical consumers of the Southern Ocean (fish, seabirds, seals, and baleen whales) and because it is the target of a commercial fishery taking some 400,000 tons a year. The CEMP hopes to use the information collected from monitoring key species and parameters to ensure that the conservation principles set down in the CCAMLR are being implemented in the management of fishing and other human activities in the Southern Ocean.

Members presented summaries of research activities conducted during the 1990/91 season in support of CEMP, as well as tentative plans for next season. The WG-CEMP accepted a draft management plan from the U.S. delegation for the protection of the CEMP monitoring site at Seal Island, South Shetlands Islands. The aim of protecting the Seal Island site is to prevent non-sanctioned development that could impede research activities.

Methods for monitoring predator parameters are set out in the CEMP publication, "Standard methods for monitoring studies." At this year's meeting, the WG-CEMP reviewed each of the standard methods and modified them where appropriate. The WG-CEMP also accepted a proposal by the United Kingdom to include the gentoo penguin (*Pygoscelis papua*) on the list of species to be monitored.

At its 1990 meeting, the WG-CEMP agreed that in order to facilitate its annual evaluation of status and trends of predator parameters, indices of monitored parameters would have to be calculated from the data available at the CCAMLR Data Centre (the depository of CEMP data). At this meeting, the WG-CEMP reviewed and accepted methods for processing, analysis, and reporting of data. It was also recommended that an intercessional workshop on sampling protocols, new methods, and technology be held.

Standard methods for monitoring environmental parameters that have a direct effect on predators were reviewed by the Group. Rennie Holt reported progress on the analysis of satellite data from the Antarctic Peninsula integrated study region (one of three study regions designated by CEMP). Of approximately 500 images available over the past 2 years, some 300 have been examined for temperature, chlorophyll, cloud cover, and sea-ice conditions. Data from these images will be presented at WG-CEMP's next meeting.

The WG-CEMP discussed ecosystem assessment problems with the expectation that by the time of the next meeting of the Group sufficient data will have been submitted to the CCAMLR data base to calculate standard predator indices. The U.S.

delegation submitted data collected at Seal Island and Palmer Station during the last two years.

Various methods of collectively evaluating predator, prey, and environmental data were considered by the Group at the meeting. Discussion focused on identifying relevant data sets and methods for effective presentation of the data. At the next meeting, the Group will most likely initiate comparisons of predator, prey, and environmental data and advise the Scientific Committee on the outcome of these comparisons. Wayne Trivelpiece noted that the data that were used to calculate the yield estimate for krill (1.5 million tons) may have been collected during a year of very high krill abundance.

The potential impact of localized krill catches was considered by the Group. An extensive temporal and spatial overlap between commercial krill harvesting and feeding by land-based predators in Subarea 48.1 (South Shetland Islands) during the predators' breeding season clearly exists. This overlap demonstrates the potential for competition between the fishery and krill-dependent predators, and raises questions concerning the degree to which fisheries may or may not be adversely affecting seabird and pinniped populations. One paper tabled at the meeting showed that within Subarea 48.1 more than 50% of the krill harvest had consistently been taken from within the foraging ranges of land-breeding predators. It was noted by the Group that restrictions on the timing and location of fisheries might be appropriate to provide land-breeding predators with sufficient prey.

The WG-CEMP addressed the topic of prey requirements for krill predators. The U.S. delegation agreed to coordinate synthesis and evaluation of data collected on the food requirements of predators in the Antarctic Peninsula integrated study region. The U.S. also agreed to coordinate data on activity-specific energy budgets and foraging ranges for penguins in all three of CEMP's integrated study regions.

The U.S. delegation tabled a paper entitled, "Volumetric analyses of Antarctic marine ecosystem data," authored by Stephanie Sexton, Jane Rosenberg, and David Demer (SWFSC). The paper describes the use of Geographical Information Systems (GIS's) and Visualization Software (VS) for integrated analyses of predator, prey, and environmental data. These computer systems have powerful utilities for analyzing georeferenced data. VS is particularly useful in analyses of true three-dimensional data such as that collected in a marine environment where each point can be described by longitude position, latitude position, and depth. The paper was very well received by the Group and may lead to cooperative work on haul-by-haul data using GIS and VS systems.

Lastly, the Group recognized the Scientific Committee's discussion concerning new and developing fisheries in the Convention area. The Commission has agreed that there is a need for a conservation measure which would ensure the development of new fisheries do not proceed before adequate data reporting and management procedures have been initiated. (J. Rosenberg, FTS 893-5600)

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

COMMERCIAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

Anchovy Management

Larry Jacobson and N. Chyan-huei Lo completed the final spawning biomass estimate for northern anchovy. The estimate (261,000 metric tons (t)) will result in zero quota for the U.S. reduction fishery during the 1990-91 fishing season. Harvests by the live bait and non-reduction commercial fisheries will be unaffected. An Administrative Report (LJ-91-19) describing the final estimate has been completed. (L. Jacobson, FTS 893-7117)

Fishery Management Plan for Coastal Pelagic Species

The Coastal Pelagics Fishery Management Plan Development Team (Sam Herrick, Larry Jacobson, Dale Squires, and Cindy Thomson, together with Patty Wolf and Eddy Kono from the California Department of Fish and Game), held its first meeting on July 26. Alec MacCall (SWFSC, Tiburon) and Gary Stauffer (AFSC) participated by conference call.

The Team held it first public meeting at the Center on August 16. In addition to Team members, Dick Parrish (SWFSC, PFEG), Carl Nettleton and Tom Crehan (Fishermen's Cooperative, San Pedro), and Bob Fletcher (Pacific Fishery Management Council and Sportfishing Association of California)

attended the meeting. Minutes of the meeting have been sent to PFMC for distribution to interested parties. Parrish agreed to help the Team by drafting a section of the fishery description dealing with physical and ecological aspects of the coastal pelagic ecosystems.

Dave Mackett, John Hunter, and Larry Jacobson have been working on organizing the work of the Coastal Pelagics Fishery Management Plan Development Team as well as trying to plan for the additional workload at the Center stemming from development of coastal pelagic fisheries. (L. Jacobson, FTS 893-7117)

Thornyhead Management

Larry Jacobson and Judy Ester mailed the final version of the thornyhead stock assessment for 1992 to the Pacific Fishery Management Council and Groundfish Management Team on July 31. The document will be published by the Council in the "Status of the Pacific groundfish fishery" document for 1991. (L. Jacobson, FTS 893-7117)

PacFIN Redefinition

Will Daspit (PacFIN Data Manager, Seattle), Larry Jacobson, Cindy Thomson, Dale Squires, and Sam Herrick developed an algorithm for estimating exvessel prices for pink tickets with no actual price data (as many as 40% of pink ticket records for some fisheries lack price and value information). The algorithm will be incorporated in the redefined PacFIN data base. (L. Jacobson, FTS 893-7117)

Summer Faculty Fellow in Economics

Jon Conrad (Professor of Resource Economics, Cornell University) concluded his tenure as Summer Faculty Fellow by completing a bioeconomic model for the northern anchovy fishery. The model does a good job of characterizing the population dynamics and economics of the anchovy fishery and leads to a new and probably better estimate of maximum sustainable yield (123,000 t per year at a total biomass level of 733,000 t), which is lower than previous estimates. Conrad worked closely with Cindy Thomson and Larry Jacobson and used some modeling approaches originally developed by Alec MacCall. A draft paper has been completed. The Coastal Pelagics Fishery Management Plan Development Team hopes to use Conrad's results in preparing new Coastal Pelagics FMPs. (L. Jacobson, FTS 893-7117)

SURVEY SYSTEMS DEVELOPMENT AND EVALUATION

Full Life Cycle Models Available for Anchovy and Sardine

Nancy Lo has completed an ICES manuscript on the Lefkovitch matrix analysis of sardine and anchovy populations. She will present this paper at the ICES symposium in La Rochelle, France, in September. This paper represents a mathematical probe of the life history characteristics of these fishes for vital parameters which control population size; fecundity, instantaneous mortality rate, and individual growth rate. One practical consequence of this work is that available information can be used to design and carry out the most economical methods for getting timely information on the capacity of stocks to withstand commercial catches. While it will not soon be practical to measure instantaneous mortality rates of juvenile fishes owing to their ability to evade nets and intense, small-scale spatial distribution patterns and wide distribution, monitoring of stage specific growth rates is now practical from direct sampling. Lo's co-authors on this paper are John Butler and Paul Smith. We have also drafted Lefkovitch matrices for jack mackerel, Pacific mackerel, and Pacific hake. (P. Smith, FTS 893-7169)

FISHERY-MARINE MAMMAL INTERACTIONS DIVISION

La Jolla, California

SWFSC FMMID Biologists Participate in Wildlife 2001: Populations Conference in Oakland, California

Doug DeMaster, Steve Reilly, Tim Gerrodette, and Sue Chivers attended the Wildlife 2001: Populations Conference held in Oakland, California, July 29-31, 1991. The international conference brought together specialists from around the world to address state of the art research and management options at the population level; it was intended for research workers and agency personnel whose interests were in the science, conservation, and management of vertebrate populations (exclusive of fish and primates). The theme of the Conference was to assess the state of the art and to set the

agenda for applied wildlife population work on the verge of the 21st century. Three papers were presented by the FMMID staff which will be published in the proceedings volume edited by D. McCullough and R. Barrett, Wildlife 2001: Populations, Elsevier Press. (D. DeMaster, FTS 893-7165)

Pinniped Management

Doug DeMaster, Division Chief for the Marine Mammal Division, presented the manuscript, "Pros and cons of pinniped management along the North American coast to abet fish stocks" which was prepared by D. P. DeMaster and J. E. Sisson. The paper was presented during the 'overabundant populations' session of the conference, and it discussed the merit (or lack thereof) of controlling pinniped populations for the purpose of enhancing fish stocks. Inherent in this approach is the assumption that predation by pinnipeds limits the net production of at least some fish populations and that any net surplus in production, caused by a culling program, can be effectively utilized in the commercial harvests. In their review, they found that four generally accepted ecological relationships work against the success of culling pinniped herds to enhance fishery production. First, prey species almost always have more than one predator; second, pinniped species rarely are dependent on one species of prey; third, the recruitment rate of most fish stocks is highly variable, and is one of the most likely factors controlling stock abundance; and fourth, fish, as a predatory group, consume more fish than do other predators (e.g. seabirds, cetaceans, and pinnipeds).

In their paper, DeMaster and Sisson stress that pinniped control management programs specifically directed at benefiting a commercial fishery should only be considered if they meet the following criteria:

1. It must be possible to provide reliable estimates on how much larger the yield would be from the fishery in question if the pinniped population were reduced by a specified amount.

2. The number of pinnipeds by age and sex class that have to be removed from the population each year to maintain the post-treatment population level must be specified.

3. The cost of pinniped management must be significantly less than the minimum estimated value of the increase in fishery production.

Information necessary in evaluating the merits of a pinniped control program using these criteria are as follows:

1. Kind, size, and amount of target species taken by pinniped species (by age, sex and area) by other predators, by commercial fisheries, and by recreational fisheries, and how the knowledge of these takes will be effected by the management program.

2. Standing stock, trends in stock size, and the relationship between net production and standing stock of the target species.

3. Population size, trends in abundance, status and net production of pinniped species.

4. Expected increase in yield (with confidence levels) resulting from cull and value of this increase in net production to the fishery and the general public.

5. Cost of the control program.

6. Proposed number (by age and sex class) of pinnipeds to be culled each year and the duration of the cull in years.

7. Long-term effects of the cull on the pinniped population.

Throughout the paper, there is no discussion on the issue of whether it is ethical to manipulate marine ecosystems. It is assumed that managers will only initiate seal control programs that meet the above criteria and that final decisions concerning implementation will be "negotiated" among all of the user groups.

In order to evaluate their proposed management strategy, they used the California sea lion and the associated fishery interactions along the west coast as a case study. This species is recovering from over exploitation in the late 19th and early 20th centuries. The current population size is at least twice the size of the population at the time the U.S. Marine Mammal Protection Act (MMPA) was passed in 1972, and is increasing. The population is estimated at approximately 120,000 animals, with a total prey consumption at around 100,000 to 300,000 tons annually.

It is unlikely that sea lions are limiting the biomass of any of their prey species. This conclusion is based on three arguments. First, sea lion prey is generally between 50 mm and 250 mm in length, and if the general theories about recruitment of sea lion prey species are correct, what regulates

these species is mitigated through variability in the annual recruitment of larval (and perhaps juvenile) age classes. Therefore, sea lion predation is affecting age classes that have already made it through the "recruitment bottleneck." Second, sea lions are likely consuming a relative small fraction of the total predation on any of their species of prey. And finally, fishery landings of many prey species in California have traditionally exceeded the total consumption of the California sea lion.

There is no doubt that California sea lions are causing financial losses to fishermen along the west coast. These losses are caused by sea lion's damaging gear and catch, and by their frightening fish away from traditional fishing grounds. However, pinniped control programs targeted at reducing the general population will do little to mitigate these interactions. Culls on the order of 25-50% of the estimated equilibrium population (the maximum cull that would ever be authorized under the existing MMPA) would only produce marginal increases in fishery production. Such increases would be very difficult to detect with any degree of statistical confidence. Only changes in the local abundance of California sea lions or the development of methods to frighten seals away from fishing grounds will address this problem.

In general, the only California sea lion control programs that could possibly satisfy the three criteria proposed in this report are those that are directed at local populations. In particular, an evaluation of a control program directed at sea lions that utilize an endangered run of steelhead in Puget Sound, WA may be warranted. A preliminary analysis suggests that without some type of pinniped control, this population of steelhead will be lost or their recovery will be severely retarded. Because of this, salmon yields can be expected to increase following pinniped control measures. The maximum number of animals would be on the order of a few hundred individuals. The cost of this removal would depend on whether animals were live-captured and translocated or killed. The cost of the former approach would likely be prohibitive. The duration of the control program is difficult to predict at this time, but conceivably animals would stop utilizing this area for hauling and feeding once culling was initiated. The net value of such a program is also difficult to measure because it involves evaluating the "worth" of recovering an endangered population as well as estimating the value of increasing the yield of this stock from zero to some substantially larger number. DeMaster and Sisson are not recommending the initiation of such a control program, but only that the merits of such a program be evaluated. The manuscript has initiated discussion which will prove useful for the management of pinniped populations along the west coast. (J. Sisson, FTS 893-7064)

Status of Dolphin Stocks in the Eastern Tropical Pacific

DeMaster also gave a presentation entitled, "Status of dolphin stocks in the eastern tropical Pacific" by D. P. DeMaster, E. F. Edwards, P. Wade, and J. E. Sisson. Their paper reviews the status of these populations relative to stock structure, current population size, levels of fishery-related mortality, and trends in abundance. Also discussed is a proposed management strategy based on managing mortality levels so that they do not exceed some fraction of expected net production rather than using the strategy of managing mortality based on trends in relative abundance.

Since 1959, over seven million dolphins are estimated to have been killed incidentally during yellowfin tuna purse seining operations in the ETP. The major species affected are the spotted dolphin, *Stenella attenuata*, and the spinner dolphin, *S. longirostris*. Common dolphins, *Delphinus delphis*, are also taken in significant numbers. The manuscript summarizes the preliminary findings made to date, which consists of a series of five surveys (1986-90) using dedicated research vessels, analysis of marine mammal sightings data collected by observers aboard U.S. and non-U.S. tuna vessels, and analysis of life history data collected by observers aboard U.S. tuna vessels. The results of these three approaches will be finalized in a report to Congress in 1992. Preliminary results indicate that there are no statistically significant trends in abundance for any of the stocks in recent years, where declines (or increases) on the order of 40 % over the last 5 years would have been necessary to be significant. However, for two stocks (i.e., the northern offshore spotted dolphin and the eastern spinner dolphin) the average estimated mortality rate resulting from the fishery over the last 5 years exceeded 2% of the population estimate. (J. Sisson, FTS 893-7064)

ALTERNATIVE FISHING METHODS PROGRAM

The NMFS Southwest Region has established the eastern tropical Pacific (ETP) gear program aimed at development of alternative (tuna-fishing) methods that will reduce or eliminate the incidental

mortality of dolphins. The program has been established at the Southwest Fisheries Science Center (SWFSC) in La Jolla, California, within the Fishery-Marine Mammal Interaction Division, to develop refinements to existing gear and fishing methods, and to develop new gear and techniques that will help maintain the ETP tuna purse seine fishery while reducing or eliminating dolphin mortality. (J. Young, FTS 893-7148)

FAD Project Initiated

In late July, 1991, 30 fish aggregating devices (FADs) were deployed in the ETP as part of a joint project between the NMFS and the Inter-American Tropical Tuna Commission (IATTC), with the majority of funding provided by Bumble Bee Seafoods, Inc. The purpose of this combined effort is to investigate the effectiveness of drifting FADs in the ETP as a means of replacing, in part, the practice of fishing on tuna associated with dolphins. The primary goal is to aggregate mature yellowfin, (*Thunnus albacares*), and bigeye, (*T. obesus*), tuna. The FADs were deployed well offshore in the area from 9°N to 11°N between 121°W and 124°W. This area and the surrounding waters where the FADs are expected to drift are "porpoise fishing" grounds where large yellowfin tuna have repeatedly been captured. IATTC historical data also show that adjacent areas, although not especially rich in natural logs, have produced larger than average yellowfin for log sets for which data have been recorded.

The 30 FADs are 10 different designs, equipped with various tracking and locating devices, and range from surface units only to surface units with arrays descending to 50 fathoms. The FADs have been deployed in 10 groups, each group consisting of 3 identical FADs. One FAD in each group is equipped with a satellite transmitter that provides positions through the ARGOS satellite system. The other two are equipped with selective-calling (SELCALL) medium-wave radio buoys which operate only when activated by a vessel's signal generator, thus extending battery life. The satellite transmitters provide positions that are accurate to within a kilometer or less. The SELCALL radio buoys can be tracked by vessels at distances of up to 200 kilometers. Several FADs are also fitted with strobe lights that activate at night, while others have radar reflectors.

FAD positions, drift directions, and drift rates are being tracked at the SWFSC and are furnished, on a daily basis, to vessel managers and IATTC field offices throughout Latin America. Although some vessels are receiving this information directly from their managing offices via telex or FAX, advisories in English and Spanish are also being issued from the NMFS radio station KHU in San Diego and from a vessel manager's office in Ensenada, Mexico. The intent is to have as many vessels of the international tuna purse seine fleet participating in this project as possible.

Pablo Arenas of the IATTC was instrumental in arranging for the transport of materials from San Diego to Manzanillo, Mexico, aboard a Mexican naval vessel, and in securing the services of the Mexican naval oceanographic vessel *Altair* for the deployment cruise. Plans call for the *Altair* or another Mexican research vessel to participate in the assessment and retrieval of the FADs in September. (J. Young, FTS 893-7148)

Separation of Tuna and Dolphins Attempted

Fishery Biologist John Young accompanied the tuna seiner *Hornet III* on a fishing trip from May 27 to July 12, 1991. During the cruise several tests were conducted in an attempt to alter the behavioral association of yellowfin tuna and spotted (*Stenella attenuata*) and spinner (*S.longirostris*) dolphins. By means of a remote buoy deployed in the water, acoustical broadcasts of yellowfin tuna feeding and of an ETP tuna-dolphin aggregation were played in an attempt to attract the fish. In various combinations with the broadcasts, as well as separately, squid and "Fish Frenzy", a commercial fish attractant recently introduced to the U.S. tuna purse seine fleet, were chummed in an attempt to generate a response from the yellowfin. Results were disappointing for the most part. Some mildly positive reactions from the fish were noted, but generally responses sufficiently strong to achieve adequate separation so that purse seining operations could be targeted on the tuna without encircling the dolphins, were not obtained. Other efforts included underwater behavioral observations of encircled dolphins and fish recorded during sets, and the collection of dolphin, yellowfin and skipjack, (*Katsuwonus pelamis*), tuna stomachs to enhance comparative food habit studies.

Funding for equipment and supplies for this cruise was provided by the United States Tuna Foundation. Vessel time and crew assistance were volunteered by Roland Virissimo. (J. Young, FTS 893-7148)

LIDAR Prototype Tested

Dolphins and other surface-oriented visual cues have been the mainstay of the ETP tuna purse seine

fishery for use in locating and catching fish for the past 30 years. The advent of a technology to locate subsurface fish or surface fish when sighting conditions are poor, from a far ranging aircraft, is being investigated.

An airborne laser-based, light-detecting and ranging device (LIDAR) prototype unit was tested May 26-28 in coastal waters off San Diego. LIDAR has been used for many years as a device to provide remote observations of atmospheric constituents. Just as enhanced backscattering from vapors and particulate materials has been used to study aerosol layers by an atmospheric LIDAR, it is thought that fish and other objects suspended in water can similarly be detected by a downward-directed laser system. Recent technological advances have made possible the construction of relatively lightweight LIDAR systems adaptable to use by single engine aircraft and small helicopters. The prototype, weighing 264 pounds, was installed in such an aircraft, a Bell Jet Ranger helicopter on loan from a tuna purse seine fishing vessel owned by Caribbean Marine Service Company of San Diego. Helicopter Maintenance Center of El Cajon, California, provided support personnel and a hangar facility for the modifications to the helicopter.

This first field testing of the prototype LIDAR system adapted for fisheries assessment and exploitation was successful in many respects. Assembled from off-the-shelf parts, it was modified for installation in the helicopter, operated without failure over a period of 3 days, and performed well in detecting fish and other reflecting elements in the water, as well as recording a bottom profile to depths to about 25 meters. Remote Sensing Industries, Inc., which was contracted to build the LIDAR unit, is working on modifications to the system as a result of these first test flights. Changes in the direction of the laser and a change in some hardware components within the unit to compress the range of signals received are planned to make it easier to operate and interpret data during flight operations. The next series of test flights is scheduled for mid-September 1991. (J. Young, FTS 893-7148)

FISHERY DEPENDENT ASSESSMENT PROGRAM

Gray Whale Status Reviewed

Steve Reilly, leader of the Ecology Program, presented a manuscript titled "Population biology and status of eastern Pacific gray whales: Recent developments" at the Wildlife 2001 Conference. His paper reviews the most recent information on abundance, distribution, life history, and ecology of gray whales with emphasis on information relevant to determining their present status. His review drew heavily from the papers and proceedings presented at 1990 International Whaling Commission's (IWC) Session on the Comprehensive Assessment of the Status of Gray Whales. Specifically, the topics covered were abundance and trends, biological parameters, and quantitative attempts to determine gray whale status.

In his paper, Reilly stated his preference for estimating abundance and trends in abundance using the set of annual surveys of the southward migration conducted since 1967-68 from points near Monterey, California. He stated that all other efforts covered incomplete and variable parts of the population, and lack sufficient corroborative data to allow reliable estimates of relative or absolute abundance.

The data consist of 16 annual surveys conducted near Monterey during a 21 year period ending in the winter of 1987-88. After incorporating correction factors for pods missed entirely in the nearshore area, those missed due to their distance offshore, those missed due to poor visibility conditions, those passing during unmonitored periods (at night, before, and after the census period), and miscounting of individuals within sighted pods, abundance estimates for the first 13 years of data ranged from 10,414 for 1971-72 to 17,577 for 1979-80, with coefficients of variation (CVs) around 11%. Reilly estimates that the population exhibited a significant annual increase of 2.5% during the 1967 to 1980 period, concurrent with an annual harvest of about 1.2% in the Soviet aboriginal fishery. Data collected for three additional surveys conducted during the years 1984-85, 1985-86, and 1987-88, proved problematic when attempting to measure trends over the entire 21 year period, but further research and analysis reduced these discrepancies. Currently, the 1987-88 estimate of 21,113 is thought to be the most accurate for a large whale population because a relatively large proportion of the gray whale population was actually observed.

There is considerable uncertainty in estimating biological parameters for gray whales, therefore, when assessing the status of cetaceans, Reilly recommends that the manager rely on assessment methods which are not dependent upon or not sensitive to them. However, using some general as-

sumptions about density dependence, the monitoring of trends in one or more biological parameters may provide qualitative but not conclusive information on population status. His review includes what is known of the most basic vital rates such as gestation period, sexual maturity, ovulation rate, pregnancy rate, and mortality rates, because these have been used in some assessments. Also, in the case of pregnancy rates, there is a strong hint of recent changes that would be expected to occur in a population nearing its carrying capacity.

Assessment of status requires agreement upon a standard or carrying capacity for comparison with the present population level. Reilly reviewed the back calculation method, the dynamic response approach, and the Bayesian approach. All three have been used to assess the status of the gray whale population.

Back calculation fits a population dynamics model to a history of catches, back to a point in time prior to exploitation, which is interpreted to be the carrying capacity (K). This approach requires an estimate of current absolute abundance to anchor the trajectory, or a series of estimates to fit. For gray whales, these estimates, in addition to qualitative information, are available to help evaluate trajectories. From Reilly's review, estimates of K for eastern Pacific gray whales range from 23,000 to 35,000. If valid, these results indicate that the 1987-88 population of 21,113 was between 60% and 90% of K.

He also reviewed the dynamic response (DR) approach which fits simple functions to series of abundance data (relative or absolute) to test for an inflection, under the assumption that such a change in growth rate represents passage through a maximum net productivity level (MNPL). The simplest application of the method is to fit a quadratic function and examine the sign of the second order term. He concluded that the DR approach provides little useful information for determining this population's status because the power of this technique is unacceptably low for populations with maximum growth rates of less than 10% per year.

Finally, he commented on a recent Bayesian approach to determining status from a series of abundance estimates using a modified logistic population dynamics model. Estimates for K were in the range of 20,000 to 50,000 with intrinsic rates of increase between 0.03 and 0.08. The posterior distribution for K had a slight, but unreliable, mode at about 23,000.

In conclusion, Reilly found that the back calculation method, in combination with the decline in pregnancy rates as well as a decline in the benthic fauna upon which gray whales feed, provide tentative evidence that the population is nearing the limits of its environment. He found no evidence that this population is in danger of extinction, and agrees with suggestions to remove it from the "endangered" classification under the U.S. Endangered Species Act. (S. Reilly, FTS 893-7164)

BIOLOGY ASSESSMENT PROGRAM

Fishery Biologists, Andrea Bright and Susan Chivers have written a report using size at age relationships and age at sexual maturity (ASM) to infer changes in population abundance. Their analysis was based on the hypothesis that the northern and southern stocks of spotted dolphins would have increased growth rates for the years between 1973 and 1989 due to increases in per capita availability of resources which accompany the decrease in stock size of dolphins caused by the ETP tuna fishery during this time period.

According to Bright and Chivers, no significant changes in ASM or rate of growth were detected in either stock. The growth rates for the two stocks were also compared because each stock has been subjected to different rates of exploitation. They found the southern stock of offshore spotted dolphins to be approximately 1 cm longer at 1 year of age and 2 cm longer at 2 years of age than animals from the northern stock. Monthly growth rate estimates were not significantly different between the stocks. The difference in length-at-age may be due to the length at birth that is estimated to be 2 cm longer for the southern stock. It is interesting that mean length at sexual maturity and mean asymptotic total adult body length for the southern stock animals are 2 cm shorter than for the northern stock. The age at attainment of sexual maturity (ASM) has been estimated to be 11.1 years for the northern stock, and 9.8 years for the southern stock, and may account for the observed differences. This lends supporting evidence for the hypothesis that there are heritable differences between the northern and southern offshore spotted dolphin. (A. Bright, FTS 893-7091)

HONOLULU LABORATORY

Honolulu, Hawaii

Review Panel's Report Completed on Research

Programs Related to the Magnuson Act

In July 1991, an external panel of fisheries scientists completed a review that assesses the Honolulu Laboratory's research programs related to the Magnuson Fishery Conservation and Management Act (MFCMA) in the central and western Pacific. The seven-page report is based on the review panel's visit to the Honolulu Laboratory during June 10-15. Members of the review panel included Robert Francis, the panel's chair and the director of the University of Washington's Fisheries Research Institute; Raymond Hilborn, University of Washington; Rick Methot, Alaska Fisheries Science Center; Michael Sissenwine, National Marine Fisheries Service senior scientist; and Jon Sutinen, University of Rhode Island.

The report praises several of the Honolulu Laboratory's research programs, such as the lobster and the armorhead research conducted by the Insular Resources Investigation. The lobster research is of "extremely high quality, very well planned and coherent," resulting in good, comprehensive data; broad, innovative stock assessments; and solid recommendations for management strategies. The armorhead research "has resulted in a useful stock assessment, an innovative survey technique that is already aiding programs at other [research] laboratories, and a substantial increase in our knowledge of this animal's ecology and future potential productivity."

The report makes a number of general recommendations concerning MFCMA-related research: The balance between the Honolulu Laboratory's research oriented towards basic fishery science and fisheries management should be determined; the relationship between the Honolulu Laboratory and the Western Pacific Regional Fishery Management Council (WPRFMC) should be clearly defined; and for the most part, the research should focus on the fishery resources within the U.S. exclusive economic zone (EEZ) under WPRFMC jurisdiction. Repeatedly the report emphasizes the need for expanding economic research, suggesting that all of the MFCMA-related research be structured around "a comprehensive bioeconomic framework" to further improve the Honolulu Laboratory's and the WPRFMC's contributions to fisheries management.

Two problems related to the bottomfish research are noted in the report--the "inadequacy of the historical State [of Hawaii] data collection system and difficulties in conducting appropriate [stock assessment] surveys." Both "severely compromise" the ability of the Insular Resources Investigation to determine the status and potential productivity of bottomfish. To alleviate the problems, the Investigation should collaborate with the State to augment fisheries data, reevaluate the data on catch per unit effort if they are to be used in defining overfishing and in determining the minimum size limits of bottomfish, and conduct comparative studies of the bottomfish resources in the main Hawaiian Islands and the Northwestern Hawaiian Islands.

For pelagic research, the report recommends that the Pelagic Resources Investigation focus on such issues as the depletion of local stocks and the competition among gear types within the U.S. EEZ. The investigation should also formulate "definitions of local overfishing; " develop a plan for "data collection, analysis and evaluation of management actions; " and most importantly "find a way to obtain catch data from all fisheries; " including the recreational, troll, and longline fisheries. Finally, more priority should be given to recreational data and data management for not only the pelagic but also bottomfish resources.

The report ranks pelagic and bottomfish research as the top priorities of the Honolulu Laboratory, because pelagic fish "are commercially and recreationally the most valuable resources under WPRFMC jurisdiction" and "bottomfish have the highest likelihood of being overfished and present the highest potential scientific gain." The research on precious corals is rated as the lowest priority. If the Honolulu Laboratory were to change any research emphasis, the report recommends that the shift be toward bottomfish research, but cautions that the research on lobster, tuna physiology, and seamounts should not be compromised as a result.

The report has been well received, and most of its points are good ones. Many of the report's recommendations, however, will require significant fiscal resources to accomplish. Before changes are implemented, the recommendations will be considered in some detail at the Honolulu Laboratory and discussed with Science and Research Director Izadore Barrett. (G. Boehlert (808) 943-1221)

FISHERIES OCEANOGRAPHY RESEARCH PROGRAM

Biology and Population Characteristics of *Squalus mitsukurii* Studied at a Seamount in the Central North Pacific Ocean

Oceanographer Christopher D. Wilson and Fishery Biologist Michael P. Seki recently completed a manuscript describing aspects of the life history and biology of the demersal shark, *Squalus mitsukurii*, from Southeast Hancock Seamount in the central North Pacific Ocean. The seamount has a small (ca. 4.5 km^2), flat-topped summit at a depth of 260 m. *Squalus mitsukurii*, which is an important component of the demersal fish fauna associated with the seamount, comprised a small fraction of the by-catch from the commercial trawl fishery on pelagic armorhead, *Pseudopentaceros wheeleri*, that effectively ceased in 1984. However, significant numbers of *S. mitsukurii* were caught incidentally with longline gear by the National Marine Fisheries Service during research cruises beginning in 1985.

Little is known about the basic life history and population dynamics of *S. mitsukurii* in contrast to the more cosmopolitan congener *S. acanthias*. Using a greater number of specimens than has been previously available, Wilson and Seki were able to provide new information on the biology and population characteristics of *S. mitsukurii* and to elucidate its role as a member of the unique fauna associated with the seamounts in the central North Pacific Ocean.

Findings included differences in depth distribution patterns and growth between sexes. Reproductive information provided estimates of minimum sizes at sexual maturity for both sexes and fecundity for females. Dietary items included a diverse selection of benthic and mesopelagic prey. Their results were compared to those from studies in other geographic areas and for *S. acanthias*.

A 50% reduction in catch rates (Figure 1) and changes in the size composition of the population suggested that the number of *S. mitsukurii* on the seamount declined dramatically over the study period, possibly as a result of overfishing during the research surveys. Seamount populations of *S. mitsukurii* were apparently unable to avoid overexploitation. (C. Wilson (808) 943-1227)

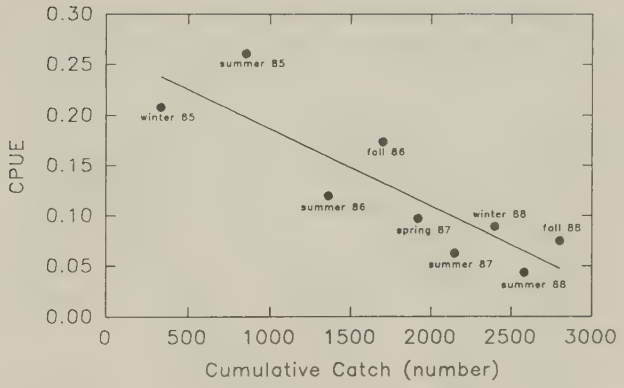

Figure 1. Catch per unit effort (CPUE) for each research cruise (filled circles) and predicted CPUE (solid line) based on the Leslie model as a function of cumulative catch for *Squalus mitsukurii* from Southeast Hancock Seamount, 1985-88.

INSULAR RESOURCES INVESTIGATION

Spiny Lobster Recruitment Linked to Subtropical Counter Current

Jeffrey J. Polovina, leader of the Insular Resources Investigation, and Gary Mitchum of the University of Hawaii recently completed collaborative work that they believe explains the drop in recruitment of spiny lobster, *Panulirus marginatus*, at Maro Reef in the Northwestern Hawaiian Islands (NWHI) during 1990-91 and also provides a means of forecasting recruitment to the lobster fishery. Maro Reef typically has accounted for the highest annual spiny lobster catches; the second highest catches have been from Necker Island. Maro Reef is 360 nmi northwest of Necker Island which is at the southeastern end of the NWHI.

From 1983 (the beginning of the collection of commercial catch data) to 1989, spiny lobster landings from Maro Reef averaged 35% of the NWHI landings, but this figure dropped to 15% during 1990-91. This relative decline is believed to be due to poor recruitment. Research sampling of pre-recruits showed a tenfold reduction in their numbers in 1990-91 compared to 1987-88, whereas pre-recruit abundance at Necker Island did not change significantly during the two periods.

Polovina and Mitchum believe the drop in recruitment at Maro Reef is due to a temporal change in the Subtropical Counter Current (SCC) which intersects the NWHI as a narrow band in the area of Maro Reef. They used the difference in sea

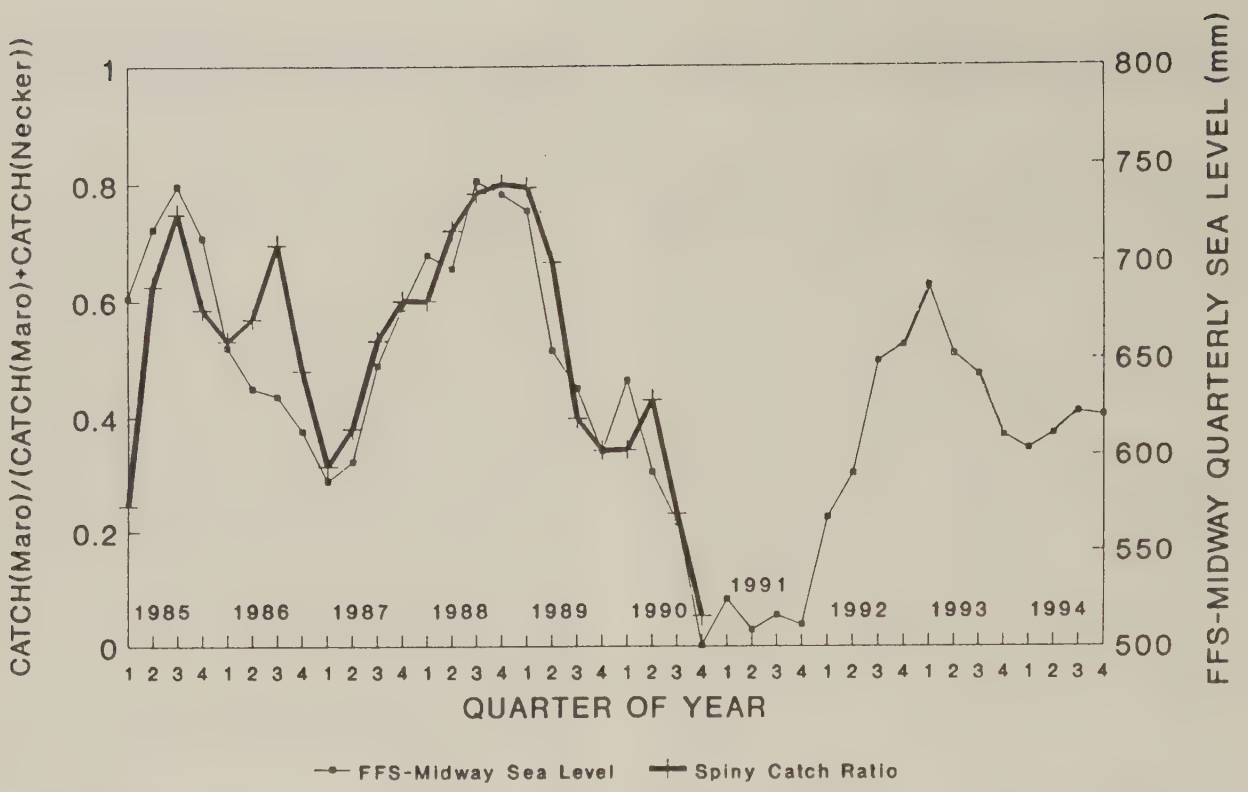

Figure 2. Ratio of quarterly catches of spiny lobster at Maro Reef to those from Necker Island plus Maro Reef, 1985-90, and the difference between sea levels (advanced by 4 years) at French Frigate Shoals (FFS) and Midway Island.

level between tide gauge stations at French Frigate Shoals and Midway Island as an index of the strength of the SCC at Maro Reef. As an index of the relative strength of recruitment to the fishery, they used the ratio of spiny lobster landings from Maro Reef to landings from both Maro Reef and Necker Island. The sea level index of current strength advanced by 4 years shows the same pattern as the index of relative recruitment at Maro Reef (Figure 2). This correlation suggests that, if the SCC is strong, recruitment to the fishery at Maro Reef will be good 4 years later, and if the SCC is weak, recruitment will be weak 4 years later. Polovina and Mitchum hypothesized that a strong SCC produces eddies and gyres in the northern portion of the NWHI; these oceanographic features result in good retention and return of larvae to Maro Reef. After the larvae settle on Maro Reef, they are caught in the fishery 4 years later, hence the reason for the 4-year lag between SCC strength and recruitment to the fishery.

Thus, the sea level index obtained from tide gauges at French Frigate Shoals and Midway Island provides a forecast for the lobster fishery. The index forecasts that recruitment to the fishery at Maro Reef will remain low in 1991 and early 1992 but should improve by 1993 (Figure 2). (J. Polovina (808) 943-1218)

FISHERY MANAGEMENT RESEARCH PROGRAM

Preliminary Results Reported for the 1991 Lobster Fishery

Fishery Technician Kevin C. Landgraf recently completed a quarterly report on the 1991 Northwestern Hawaiian Islands (NWHI) lobster fishery. A 180-day emergency closure of the lobster fishery went into effect on May 8 and will continue until June 30, 1992. The closure was necessary because of low catch rates as well as low recruitment to most the NWHI banks.

During the abbreviated lobster fishing season in 1991, 7 vessels took 15 trips to the NWHI, compared with 10 vessels making 10 trips during a similar period in 1990. A number of vessels anticipating the closure had already shifted to other fisheries, particularly to the NWHI bottomfish and Hawaii longline fisheries. Some vessels left Hawaii, intending to return when the lobster fishery reopens.

Total effort in the lobster fishery during January-May 1991 was more than 212,000 trap-hauls, which is a 71% increase over a similar period in 1990, but is only 18% of the total fishing effort in 1990. Total landings in 1991 equaled 95,000 legal spiny lobster, *Panulirus marginatus*, and 28,000 legal slipper lobster, *Scyllarides squammosus*. Catch rates remained low, however, at 0.45 and 0.13 legal spiny and slipper lobsters, respectively, per trap-haul. One encouraging sign for 1992 is that the catch rates of sublegal lobsters rose substantially in the first 5 months of 1991. Price levels also continued to rise, but buyers have been concerned that the potential 1-year closure, followed by a shorter annual season as proposed by the Western Pacific Regional Fishery Management Council (WPRFMC), may cause marketing problems once the fishery reopens.

Landgraf's quarterly report of the 1991 lobster fishery, along with his "Annual report of the 1990 western Pacific lobster fishery" (SWFSC Administrative Report H-91-06), was sent to all active lobster fishing vessel captains and owners. (S. Pooley (808) 943-1216)

Longline Observations Summarized for 1990-91

Robert A. Dollar, fishery technician, completed "Summary of swordfish longline observations in Hawaii, July 1990-March 1991" (SWFSC Administrative Report H-91-09). This report describes the results of 10 observer trips made during 1990-91 to investigate the potential interactions between protected species (e.g., sea turtles, seabirds, and particularly Hawaiian monk seals, *Monachus schauinslandi*) and longline vessels fishing for swordfish, *Xiphias gladius*, in Hawaii. The observers recorded any interactions with protected species and collected biological data on the swordfish caught, catch and effort data, and information on the fishing operations of the vessels. Observers participating in the program included four biologists and biological technicians from the Honolulu Laboratory and two marine mammal observers from the La Jolla Laboratory.

No Hawaiian monk seals were observed during these trips, although three sea turtles and a number of whales, porpoises, and seabirds were seen interacting with the gear in various ways.

Interestingly, sharks made up the largest component of the catch (33% by number), although they were generally not landed for they have little commercial value in Hawaii. The next largest component was swordfish (26%), followed by tunas (17%).

The logbooks of vessels longlining in Hawaii the first half of 1991 also were summarized in a report by Dollar and Stacey S. Yoshimoto, operations research analyst. Their report, which will be circulated to other agencies of the National Marine Fisheries Service (NMFS) and to the WPRFMC, reveals that 560 trips were taken by 130 longline vessels in January-March and 546 trips were taken by 127 vessels in April-June. (The number of trips for the two quarters cannot be combined because of the potential for trips overlapping both time periods.)

Total effort in the first quarter of 1991 equaled 3.46 million hooks, compared with 3.57 hooks in the second quarter. Effort outside Hawaii's 200-mile exclusive economic zone (EEZ) increased substantially, from 820,000 hooks in the first quarter to 1.3 million hooks in the second quarter, while effort within Hawaii's EEZ declined (primarily in the main Hawaiian Islands).

Catch per unit effort (CPUE; catch per 1,000 hooks) for billfish (e.g., blue marlin, *Makaira mazara*; striped marlin, *Tetrapturus audax*; swordfish) rose slightly between the two quarters, while the CPUE for other pelagic management unit species (e.g., mahimahi, *Coryphaena hippurus*; ono (wahoo), *Acanthocybium solandri*; and sharks) increased substantially, largely due to an increase in the mahimahi catch. The CPUE for tunas (e.g., bigeye tuna, *Thunnus obesus*, and yellowfin, *T. albacares*) declined. (S. Pooley (808) 943-1216)

Report on 1990 Bottomfish Fishery Completed

Kurt E. Kawamoto, fishery biologist, recently completed "Bottomfish fishery in the Northwestern Hawaiian Islands, 1990" (SWFSC Administrative Report H-91-08), which summarizes the activity in Hawaii's snapper, grouper, and jack fisheries. Using data complied through the NMFS shoreside market monitoring program, Kawamoto's report reveals that the total landings in the NWHI increased 40% in 1990 to 420,000 lb (190 t; Table 1) as a result of substantially increased effort in the Mau Zone (open access zone), one of the management areas in the NWHI. Despite this 40% increase, landings continued to lag behind the peak catches of previous years (over 1 million lb in 1987). Five

Table 1. Landings (in thousands of pounds) and revenue (in thousands of U.S. dollars) by Hawaii's bottomfish fishery, 1989-90. Data were compiled by the Fishery Management Research Program.

	Landings and Revenue	
	1989	1990
NWHI landings	300	420
NWHI revenue	$760	$1,070
MHI landings	1,230	830
MHI revenue	$3,860	$3,300
Combined total:		
Landings	1,530	1,250
Revenue	$4,620	$4,370

vessels operated in the Ho'omau Zone (limited entry zone) of the NWHI, while 14 vessels operated in the Mau Zone.

Most vessel captains commented that catch rates of target species continued to decline. Fishermen have theorized that, although increased fishing pressure has had a detrimental effect on bottomfish stocks, the abundance of sharks and other predators has had an even greater adverse effect. The shark problem, which is more prevalent in the Mau Zone, has caused major disruption, wasting fish and fishing time. It has been reported that sometimes only 1 in 20 hooked fish is landed.

In the main Hawaiian Islands, landings in 1990 dropped to 830,000 lb (380 t; Table 1), down 33% from 1989 primarily due to the decline in a cyclically available grey snapper, *Aprion virescens*.

Market prices were relatively stable in 1990, although landings by bottomfish vessels in the main Hawaiian Islands received higher prices (up 25%). A substantial increase in the volume of imported fresh snappers, many from Fiji and Tonga, has tended to have a greater impact on prices of snappers from the NWHI than on those from the main Hawaiian Islands. Snappers from the main Hawaiian Islands continued to receive premium prices because of superior species composition and longer shelf life.

Kawamoto's report was circulated to all bottomfish vessel owners and captains and to the WPRFMC for inclusion in its annual report. (S. Pooley (808) 943-1216)

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

New Methodology for Estimating Underlying Trends from Survey Data

Many examples of fishery monitoring and relative population estimation involve correlated observations taken over time and space. Given these data, the problem for fisheries science is to nonparametrically model stochastic trends and seasonal effects, that apart from a time shift and possible scaling factor, are common to a (possibly) changing (in dimension) vector of observations. The data are nonstationary, as typically there is a common trend of unknown form, there are time varying, random seasonal effects, and there are fixed effects that are part of the monitoring system, all of which are reflected in an observation. From these observations, estimates of the unseen population are desired.

Operations Research Analyst Roy Mendelssohn and Professor Robert H. Shumway (Division of Statistics, UC Davis) started this work to produce estimates of the relative abundance of northern anchovy from spotter pilot data, but the methodology is not limited to this problem.

Various methods have been used to estimate the biomass of northern anchovy along the California coast. Before 1980, a larval census method was used, and from 1980 on an estimate was derived using the "egg production method." Presently there is a desire to combine estimates produced by the egg production method with auxiliary information. In particular, since 1962, aerial fish spotter pilots working with the commercial purse seine fleet off central and southern California have recorded on their flight logsheets estimates of tonnage, numbers of schools of fish, number of fish, and other school characteristics for any sighting along their flight path.

To produce overall anchovy density estimates from the spotter pilot data it is necessary to correct or standardize the observations. That is, it is believed that the likelihood of a particular observation depends on the pilot who made the sightings, on the time of day (day/night) of the flight, on the season in which the flight took place, on the region in which the flight took place, and on year-to-year differences. At the present time, the influence of

each of these factors is estimated from the data using a linear model. Each observation can then be corrected for any of these effects to produce comparable estimates of anchovy density.

In terms of our more general problem, the regions represent the spatial aspect of the problem, and the pilot, day/night and related factors are the fixed effects. What is desired is an estimate of the common (across regions) unobserved trend in the anchovy density, corrected also for seasonal variations and correlation in time.

There are problems with using a fixed-effects model to standardize the observations. The (relative) year effect in particular tends to overparameterize the model, using up degrees of freedom needed for the other parameters. A fixed-effects model also restricts the seasonal component to be purely deterministic. Given the variability in the ocean this is probably an unrealistic assumption. Further, a fixed-effects model ignores correlation in time and space in the observations, as well as temporal dependence in the underlying component. Since estimates of the year effect are independent, new observations are only reflected in the estimates of the trend by any changes they cause in the estimates of the other fixed-effects. This can produce estimates of anchovy density that are inconsistent with past estimates, with no way of "updating" the previous estimates (Lo 1990). Intuitively, it seems reasonable that the underlying population dynamic is both temporally dependent as well as "smooth" to a given degree, and our estimation scheme should reflect this belief.

Mendelssohn and Shumway show how this problem can be cast as a State-Space Model with a Smoothness Prior. The smoothness prior allows for nonparametric, stochastic estimates of the trend and seasonal components, allowing a tradeoff between fit to the observations and smoothness of the components, essentially a tradeoff between variance and bias. The State-Space Model allows for a more general error structure, in particular autocorrelated errors can be included in the model. An EM-Kalman Filter algorithm is derived which produces maximum likelihood estimates of the fixed-parameters, and minimum mean-squared error estimates of the unobserved components. The algorithm has the advantage of being simple to program, and at each iteration of the EM algorithm, the maximization step reduces to standard calculations from multivariate regression.

When applied to the anchovy spotter pilot data, the new algorithm produces quite different estimates of the fixed-effects in the model (Tables 1 and 2), and much lower estimates of both the log of the tonnage per positive block as well as for the log of the proportion of positive blocks (Figures 1 and 2).(R. Mendelssohn (408) 646-3311)

Table 1. Estimate of fixed-effect parameters for the log tonnage per block from the linear and state-space models.

Parameter	Linear model	State-space
D	-1.1825	0.5873
R1	2.0992	0.1274
R3	-0.8152	0.2195
R4	-2.5601	0.2428
R5	-1.2764	-0.3084
P2	1.2321	1.4435
P3	2.7065	1.7049
P5	0.5203	1.6853
P7	2.9931	1.6301
P8	1.7926	1.8865
P9	0.6825	1.5444
P11	-0.0816	1.8008
P12	2.3628	1.3555
P14	-0.7739	0.4683
P15	-0.0720	1.6360
P16	0.5051	1.6238
P17	1.0732	2.0316
P18	0.8911	1.8589
P19	-1.4638	2.3170
P21	0.8687	1.5151
P22	-0.6208	1.4758
P23	-0.8531	1.6828
P24	-0.9584	1.7727
P25	1.1923	1.8576
P26	3.6336	1.7727
P27	-0.4650	2.3838
DS2	0.3453	0.0296
DS3	-0.2325	-0.2888
DS4	-0.1202	-0.1085
DR1	-3.3055	0.6807
DR3	0.2451	-0.3239
DR4	2.1308	-0.1055

Table 2. Estimate of fixed-effect parameters for the log of the proportion of positive blocks estimated from the linear and state-space models.

Parameter	Linear model	State-space
D	-0.0792	0.1477
R1	0.0409	0.2446
R3	-0.1510	-0.0147
P3	0.0997	0.2261
P5	-0.0593	0.1767
P7	0.0281	0.2121
P8	-0.0601	0.1763
P9	0.0308	0.1387
P11	-0.0547	0.0685
P12	0.1285	-0.0757
P14	0.0295	0.1763
P15	-0.0089	0.2412
P16	-0.0716	0.2434
P17	0.0263	0.1825
P18	0.1726	0.0881
P19	0.1568	0.2045
P21	-0.0729	0.1804
P22	0.0499	0.1804
P23	0.1643	0.0848
P24	0.2739	0.1944
P25	0.2813	0.0245
P26	0.1760	0.1875
P27	0.1720	0.2659
DS12	0.1126	-0.0448
DS13	-0.0244	-0.0225
DR1	-0.0170	-0.1846
DR3	0.1551	-0.0355

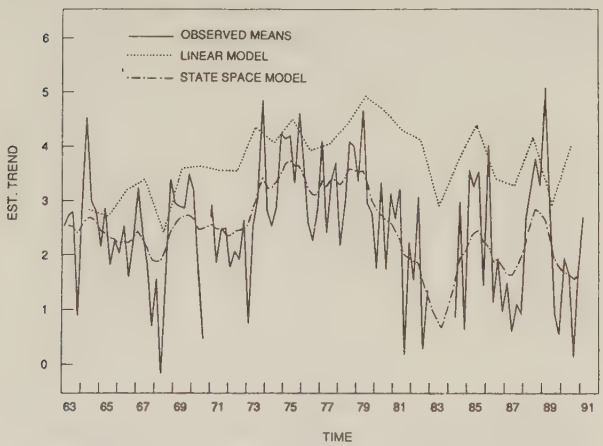

Figure 1. Estimates from the State-space model. Observed means after subtracting the fixed-effects estimated from the state-space model (solid line), the year effect from the linear model (dotted line) and the trend component from the state-space model (dashed line), for the log of the normalized tonnage per positive blocks.

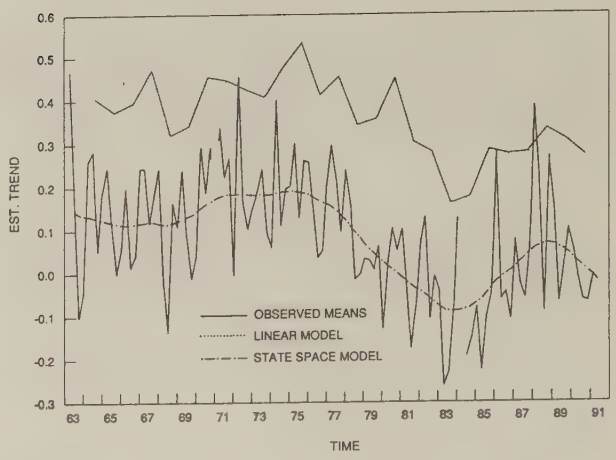

Figure 2. Estimates from the State-Space model. Observed means after subtracting the fixed-effects estimated from the state-space model (solid line), the year effect from the linear model (dotted line) and the trend component from the state-space model (dashed line), for the log of the proportion of positive blocks.

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

12th North Pacific Albacore Workshop Held In Shimizu, Japan

In July, the Southwest Fisheries Science Center co-hosted the 12th North Pacific Albacore Workshop with the National Research Institute of Far Seas Fisheries in Shimizu, Japan. Eight participants from the U.S. attended the workshop, which was considerably more formal than in previous years because of involvement of driftnets in interception of albacore in the North Pacific Ocean. The following is a brief summary of the workshop's conclusions.

Summary of the 12th North Pacific Albacore Workshop

The 12th North Pacific Albacore Workshop was held at the National Research Institute of Far Seas Fisheries (NRIFSF), Shimizu, Japan, July 23-25, 1991. Thirty-four scientists from Japan and the United States met to review recent data and re-

search, and to evaluate the condition of the North Pacific albacore stock. The workshop was the most recent in a series which began in 1975. Participants and members included the NRIFSF; Southwest Fisheries Science Center, La Jolla, California; Pacific Biological Station, Nanaimo, British Columbia; and the Institute of Oceanography, National Taiwan University, Taipei, Taiwan.

North Pacific albacore are caught in several fisheries including the Japanese pole-and-line, longline and driftnet fisheries; the United States and Canadian troll fisheries; and the Taiwanese and Korean longline and driftnet fisheries. Annual catches of North Pacific albacore peaked in the early 1970's in excess of 100,000 metric tons (t). Since then total annual catches have continued to decline to near 40,000 t in recent years. The declines in catches have been predominantly in the Japanese pole-and-line and the U.S. troll fisheries. Over the same period the Japanese and Taiwanese longline catches have remained relatively constant. Increases in catch have been recorded for the driftnet fleets of Korea, Taiwan and Japan. Catches by the Japanese purse seine fleet have also shown modest increases.

The Workshop examined catch per fishing effort series as indicators of the abundance of various segments of the population. The trend in young fish abundance was best reflected by the surface fisheries, and the trend in adult abundance was best represented by the longline fisheries. Catch per fishing effort in both the U.S. troll fishery and the Japanese pole-and-line fishery are currently stable and about 30% lower than that before 1977. Catch per fishing effort in the Japanese longline fishery is relatively flat, declining slowly in recent years.

The workshop produced a series of recommendations for research and analysis to determine more clearly the status of the stock and the effects of the various fisheries on the stock.

A written report being prepared detailing the Workshop's discussions and conclusions will be made available to the public.

The results of the workshop showed that the U.S. fishery is "downstream" from the other surface fisheries in the North Pacific, so is more severely affected by interception of albacore migrating toward the U.S. fishery. Because of the substantial catch taken by the driftnet fleets, they are probably a major factor responsible for the lower recent catches by the U.S. fishery as well as other traditional albacore fisheries in the North Pacific. (N. Bartoo, FTS 893-7073)

High Seas Drift Net Assessment Program

Four albacore observers remained at sea documenting the interaction between U.S. albacore troll vessels and Asian high-seas drift gillnet boats. Preliminary reports (via radio) indicate good to moderate fishing within the North Pacific Transition Zone throughout the period. Incidence of albacore damaged by contact with drift gillnets ranged from zero to 10% of daily catches. These results are consistent with data collected last year.

The albacore mortality experiments scheduled in August aboard the *R/V Townsend Cromwell* were canceled. (D. Holts, FTS 893-7186)

MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

Dolphin Mortality in U.S. Tuna Fishery Declines in 1990 and 1991

The estimated number of dolphins killed in the U.S. eastern tropical Pacific tuna purse seine fishery in 1990 was 5,083, down 60% from the estimated 1989 kill of 12,643, according to data collected by on-board observers from the National Marine Fisheries Service (NMFS). The 1990 dolphin kill was well below the allowable annual quota of 20,500, and was the lowest on record for the U.S. fleet.

The major reasons for the marked decrease in dolphin kill in 1990 were the reduction in the size of the U.S. fleet in the eastern Pacific, and an increase in the fishing effort on non-dolphin-associated tuna by the remaining U.S. vessels; both consequences of the U.S. tuna canners' decision in April 1990 to purchase only "dolphin safe" tuna.

In 1990, observer coverage was 100%; observers were on-board 92 U.S. tuna purse seiner fishing trips monitoring 1,845 sets on dolphins. Forty-four of those trips were with NMFS observers while the remainder (48 trips) were with the Inter-American Tropical Tuna Commission observers.

The dolphin kill-per-set rate in 1990 was 2.8, down 22% from the 1989 rate of 3.6. It was the lowest rate achieved by the U.S. fleet since 1979, when the kill-per-set rate was 2.7 (Figure 1). The dolphin kill-per-ton of tuna rate in 1990 was 0.14, down 26% from the 1989 rate of 0.19. This is the lowest per-ton rate on record (Figure 2). The average tuna catch per observed dolphin set in 1990

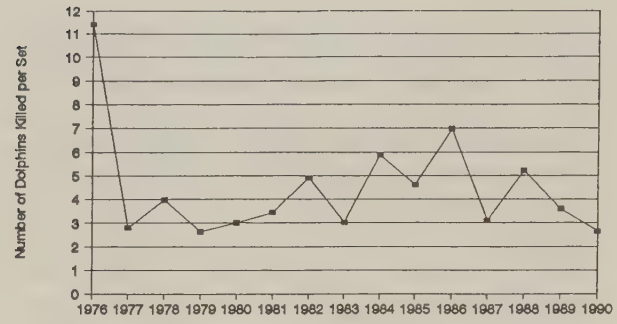

Figure 1. Average number of dolphins killed per set on dolphins for observed U.S. trips, 1976 to 1990.

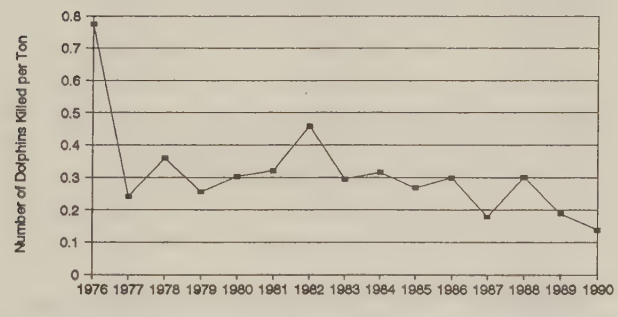

Figure 2. Average number of dolphins killed per ton of tuna caught in dolphin sets for observed U.S. trips, 1976 to 1990.

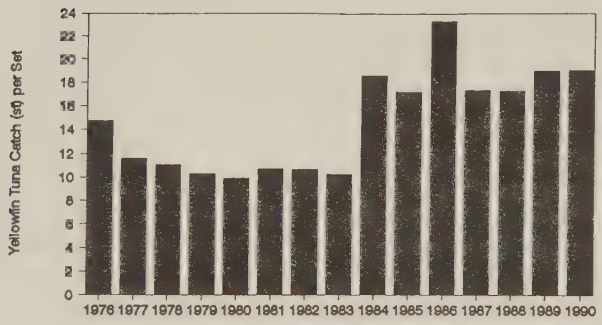

Figure 3. Average tuna catch per set on dolphins for observed U.S. trips, 1976 to 1990.

was 19.1 short tons, virtually the same as in 1989 (Figure 3).

Based on preliminary data covering the first 6 months of 1991, the dolphin kill and kill-per-set rates continue to fall: 373 dolphins were killed in 147 sets for a kill-per-set rate of 2.5. Of the 12 U.S. purse seiners that were active in the eastern tropical Pacific and permitted to set on dolphins, only 5 actually made dolphin sets during the first half of 1991. (A. Jackson, FTS 893-7048)

Seychelles Purse Seine Data Updated

Biological Technicians Laura Halko and Cheryl Brown have completed updating the first quarter 1991 Seychelles Fishing Authority data of tuna purse seine catches in the Western Indian Ocean. Data are summarized in LOTUS spreadsheets, and cover the period 1983 to the present.

From January to March 1991, the number of active purse seiners remained constant at 43 (14 French, 18 Spanish, 2 Mauritian, 4 Soviets, 3 Japanese, 1 Panamanian, and 1 from St. Vincent). This represents a significant drop from last year's 1st quarter average of 52 vessels.

Catch rates are substantially higher than those for the same period in 1990 (Figure 4), averaging 22.5 metric tons (t) per day in 1991 compared to 15.3 t/day in 1990. The location of the fishery also fol-

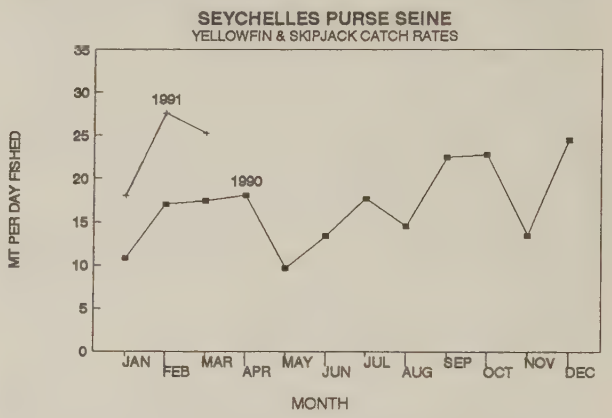
SEYCHELLES PURSE SEINE
YELLOWFIN & SKIPJACK CATCH RATES
MT PER DAY FISHED
0 5 10 15 20 25 30 35
1991
1990
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTH

Figure 4. Catch rates (metric tons/day fished) for purse seiners fishing in the Western Indian Ocean, 1990, and first quarter 1991.

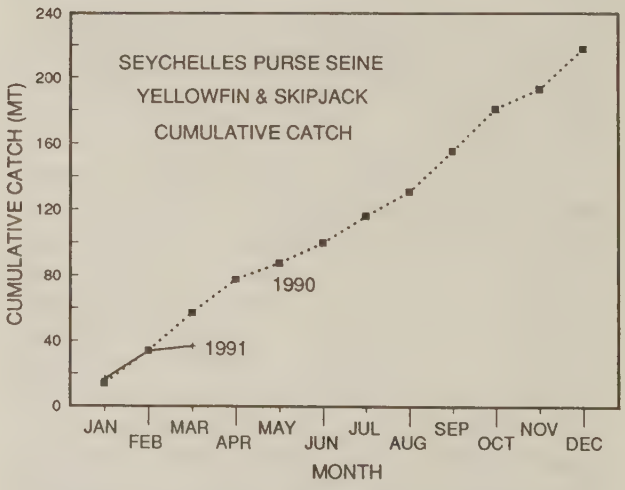

Figure 5. Cumulative catches (metric tons) for purse seiners fishing in the Western Indian Ocean, 1990, and first quarter 1991.

lowed a trend similar to previous years in that most vessels were active to the east of the Seychelles EEZ and moved south towards the Mozambique Channel in March.

The cumulative catch for the first quarter 1991 stands at 37,684 t, 35% lower than the 58,127 t value for the same period in 1990 (Figure 5). The species breakdown of catches for the first quarter of 1991 was 81% yellowfin and 17% skipjack tuna, compared to 53% yellowfin and 45% skipjack during the first quarter 1990. Yellowfin tuna made up 88% of the catch in January and February and dropped to 67% in March, an expected trend during this time of the year. (A. Coan, FTS 893-7079)

South Pacific Albacore Data Submitted

Al Coan, mathematical statistician, has completed summarizing data collected from U.S. jigboats fishing in the South Pacific during the recently completed 1990-91 fishing season. The data are being submitted to the South Pacific Albacore Research Working Group in preparation for a November meeting.

Approximately 59 U.S. jigboats participated in the fishery and caught an estimated 6,400 t of albacore. The fishery concentrated in areas between 35°S to 45°S latitude and 140°W to 165°W longitude. The average catch rate was 195 fish per day fishing, 29% lower than during the 1989-90 fishing season. Over 8,000 fish were sampled for length in American Samoa, where the majority of the catch was landed. Albacore ranged in size from 46 to 107 cm in fork length. The majority of the fish landed were between 61 and 76 cm (Figure 6), with an average size of 70.9 cm. A greater proportion of large fish (>71 cm) were landed during the 1990-91 season than during the 1989-90 season, when the overall average size was 67.4 cm. (A. Coan, FTS 893-7079)

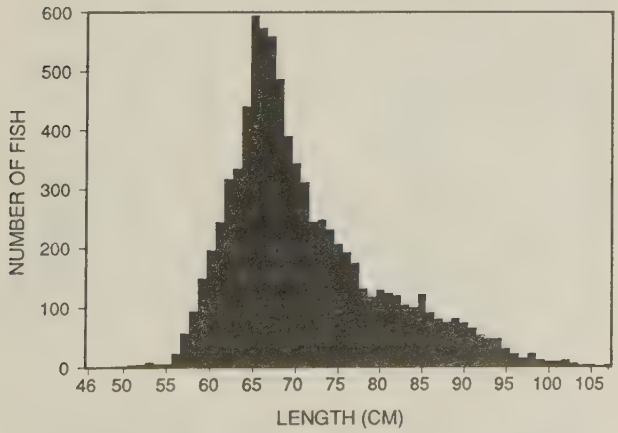

Figure 6. Sizes of albacore landed by U.S. jigboats participating in the 1990-91 South Pacific albacore fishery.

TIBURON LABORATORY

Tiburon, California

DIRECTOR'S OFFICE RESEARCH

Report on an International Stock Assessment Workshop

Alec MacCall attended an international "Workshop on Techniques for Biological Assessment in Fisheries Management" hosted by the Arbeitsgruppe Theoretische Ökologie at the Forschungszentrum in Jülich, near Aachen, Germany, July 17-24. The workshop was sponsored by Project Prospero and the European Commission, parent agency to EC/ICES fishery management. Conveners were Jacquie McGlade, Arbeitsgruppe; John Shepherd, Lowestoft; Doug Butterworth, University of Cape Town; and the late John Gulland. A report of the workshop is in preparation.

The workshop addressed several topics of current or emerging concern. The so-called "retrospective problem" is being studied intensely by researchers on both sides of the Atlantic. Apparently all of the VPA-related methods share a tendency for the current year abundance estimate to differ systematically from the converged value obtained from the benefit of subsequent data. In most cases, present abundance is consistently overestimated with respect to converged values, in some it is underestimated, but in very few there is no consistent pattern. Patterns are stock-specific, but not necessarily species-specific. The source of the "retrospective problem" is still not known.

Another emerging concern in VPA-based assessments is the high frequency of "domed selectivity curves," where estimated F rises up to some intermediate age and then falls at older ages. This pattern has become apparent with widespread use of separable VPAs which estimate fishing mortality rates by means of independent additive year and age effects. In some cases the domed pattern is reasonable, such as in gillnet fisheries where larger fish may be less susceptible to the gear. However, in many cases we must assume that the fish become

less available to the gear for distributional or behavioral reasons which are difficult to confirm (assuming the VPA treatment to be correct). Alternatively, we may be using misspecified models. For example, increasing natural mortality rate (M) with age can produce similar patterns if M is wrongly assumed to be constant with age in the model.

Harvest formulas or adaptive quota policies are receiving increased attention among fishery scientists, and soon may be put into practice in locations other than southern California. The International Whaling Commission has been trying to develop a new robust approach to management of whale harvests and has independently discovered quota formulas. Ray Hillborn (University of Washington) has also been investigating the properties of similar policies which have been applied to salmon management in the northeastern Pacific. The most extensive experience with this form of adaptive quota policy has been in California's pelagic fish management, where they have been in use for nearly 20 years. The adaptive linear formula was originally developed by Richard Parrish (now of SWFSC/PFEG), and this approach was later applied in the northern anchovy Fishery Management Plan (FMP). The quota formula approach to fishery management was new to many of the ICES participants and was received enthusiastically as a possible method of countering their tendency toward "status quo" management of depleted EEC stocks.

As VPA-based methods have moved from accounting to a statistical basis, and with the convenient computing power provided by modern desktop computers, we have improved our ability to describe the statistical uncertainty in the resulting abundance estimates. This is being taken even farther in assessment and management of New Zealand's fisheries, where a serious attempt is being made to use Bayes methods to generate posterior abundance probability distributions, which are then used in a risk analysis. Estimated variances of abundance estimates obtained this way can be misleading because they provide insufficient information on the shape of the posterior probability distribution. An approximate posterior probability distribution for abundance can be obtained from statistical VPA analyses by "likelihood profiling," i.e., calculating the relative probability over a wide range of possible abundance values (while letting other parameters assume their best-fitting values without specifying prior distributions). (A. MacCall, FTS 556-0565)

Difficulties in Analysis of Historical Klamath Chinook Runs

Separation of individual age classes from the historic Klamath basin chinook salmon spawning run data has been found to be impractical. Past marking of hatchery fish with coded wire tags has shown that life histories of Klamath basin chinook are highly variable both among years and among local stocks (Figure 1). In concert with the variable but unknown contribution rates of individual stocks to the total run, this variability in maturation probabilities makes it virtually impossible to estimate individual year-classes from historical aggregate run data.

Fishery impacts and management options are currently assessed using age-structured models, yet the only reliable age-structured data for the basin comes from marked fish that represent about 10% of the production of the Trinity River and Iron Gate hatcheries. Accurate estimates of the age composition of spawning runs and of year-class strength are considered crucial for improving assessment and forecasting of Klamath basin chinook salmon. Since refinements in the historical data now appear

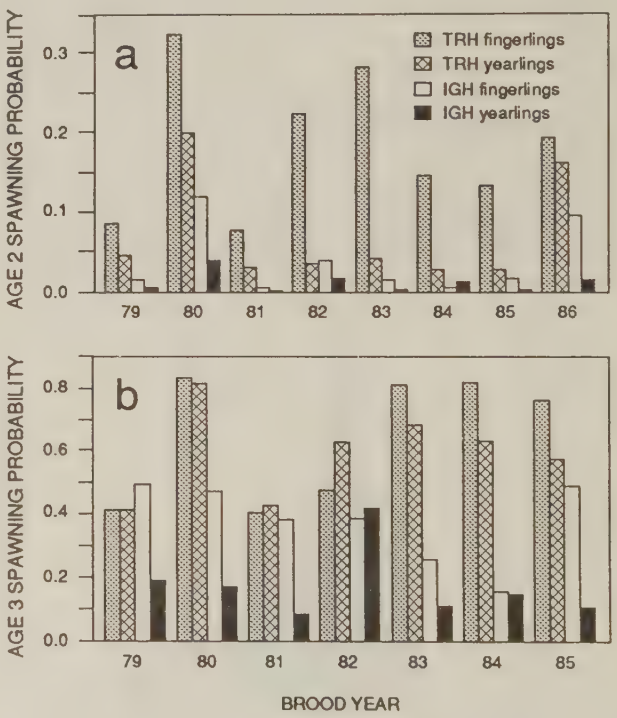

Figure 1. Probabilities of maturation and spawning at age 2 (a) and age 3 (b) for chinook salmon released as fingerlings and as yearlings from Trinity River Hatchery (TRH) on the Trinity River, and Iron Gate Hatchery (IGH) on the Klamath River.

unlikely, efforts to improve forecasting and assessment of Klamath chinook are focusing on the future. Under the direction of the Klamath River Technical Advisory Team, the U.S. Fish and Wildlife Service and the California Department of Fish and Game have begun a systematic sampling program to determine the age structure of the entire spawning run. Concurrently, Robert Kope is evaluating the use of simpler aggregated models, without age structure, for assessment and forecasting. (R. Kope, FTS 556-0565)

GROUNDFISH COMMUNITIES INVESTIGATION

Methods Used to Identify Juvenile Rockfishes Described in Manuscript

A major topic of study at the Tiburon Laboratory has been recruitment in rockfishes, *Sebastes* spp., which requires specific identification of early juveniles. There has been a problem in that these juveniles often lack the generally recognized diagnostic characters of the species, which are features of the adults. To solve this problem, a number of Tiburon researchers have developed ways to identify rockfish juveniles. Because these identification processes should be useful to other investigators, they have been described in a compilation of manuscripts edited by Fishery Biologists Tom Laidig and Peter Adams of the Groundfish Communities Investigation. This work entitled "Methods used to identify pelagic juvenile rockfishes (genus *Sebastes*) occurring along the coast of central California," will be submitted for publication as a NMFS Technical Memorandum.

The compilation includes five manuscripts covering a variety of methods used to identify juvenile rockfishes. One by Tom Laidig and Wayne Samiere considers pigmentation differences between two close relatives, the black rockfish (*S. melanops*), and the yellowtail rockfish, (*S. flavidus*). Two manuscripts describing use of bony structures to distinguish various rockfish species will be particularly useful to those who need to identify rockfishes in gut contents. In one of these, Kelly Silberberg describes using the cleithrum to differentiate 10 different species, while in the other, Tom Laidig and Wayne Samiere describe using bones of the caudal fin and caudal peduncle to distinguish 11 species. Two meristic keys are included, one by Peter Adams and Wayne Samiere and the other by Sharon Moreland and Carol Reilly. The first of these is a computerized expert key based on meristics, mainly gillraker counts, while the second incorporates meristic data, spawning times, geographical occurrence, and personal observations. The information provided by this work will help anyone who has need to identify juvenile rockfishes. (T. Laidig and P. Adams, FTS 556-0565)

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATION

Studies on the Mode of Viviparity in Yellowtail Rockfish

In the past few years, the availability of data has increased, suggesting that species of the genus *Sebastes* are not strictly lecithotrophic (i.e., ovoviviparous), but in a species-specific way, demonstrate varying degrees of matrotrophy (i.e., viviparity). These data mostly describe changes in energy content (calculated from calorimetry and respirometry) and weight of ovaries or embryos between fertilization and parturition. The results of these studies show that weight changes range from about +20% to -20% and energy content declines between about 5% and 35%. Based on criteria developed from oviparous species, whose mode of maternally-contributed nutrition parallels extreme lecithotrophy, losses of weight between 25% and 35% indicate lack of maternal inputs after fertilization, therefore lecithotrophic development. Clearly, weight or energy net gains following fertilization characterize matrotrophy.

Using lipid and protein contents in ovaries of female yellowtail rockfish, *Sebastes flavidus*, according to stage of reproductive development, we assessed the changes in organic weight and energy content during the annual cycle. Carbohydrate, in the form of glycogen, is an insignificant source of mass or energy, never amounting to more than 0.2% of ovary wet weight. Data were analyzed by ovary maturation stage (OMS) and adjusted for variations in size of the females. Ovary maturation stages 1 through 4 represent oocyte development, OMS 5 fertilization, and OMS 6 through 8 embryonic stages. Females in OMS 9 were spent. Gestation lasts for only about 30 days; thus embryos do not remain in any of the three embryonic stages for very long, and the population of yellowtail studied has, for the most part, synchronous annual reproductive development. Since our sampling interval was monthly, each embryonic OMS (6-8) consisted of a relatively small sample size. Therefore, these results should be considered preliminary.

As would be expected, lipid and protein increased in ovaries during oocyte maturation to fer-

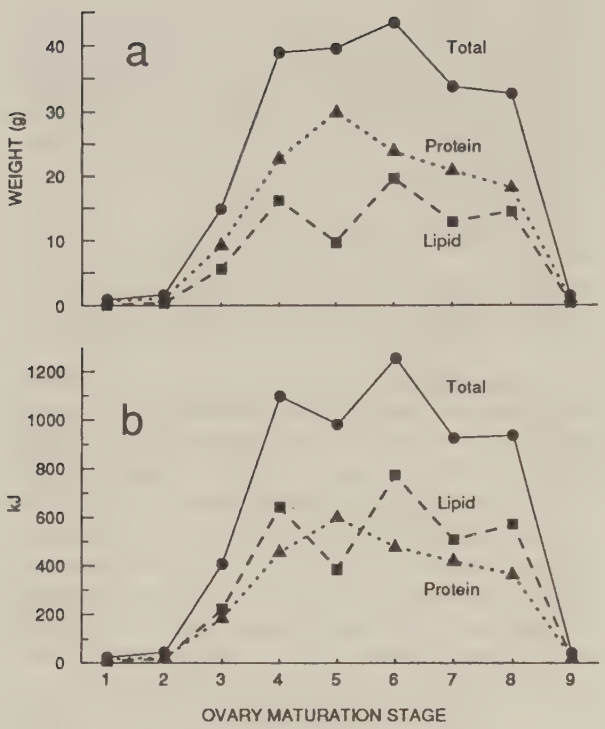

Figure 2. (a) Organic weight and (b) energy in ovaries of yellowtail rockfish, *Sebastes flavidus*, according to stage of ovarian maturation during the annual reproductive cycle. Means were adjusted to eliminate the effect of size of female.

tilization (Figure 2). The decline in lipid seen for OMS 5 was probably an artifact, since it was based on a small sample size and lipid concentrations are highly variable individually. If mean organic weight and energy content at fertilization are approximated by the means of OMS 5 + 6, and OMS 8 represents embryos soon to be born, then there were weight and energy declines of 21% and 16%, respectively. These losses are within the ranges established for other members of the *Sebastes* genus, but also approach the margins of the envelope ascribed to purely lecithotrophic species. Further, the data indicate an increase in lipids between OMS 7 and OMS 8 that could suggest maternal input during gestation. This was supported by maternal serum analyses which revealed statistically significant increased transport of phospholipids and cholesterol when embryonic stages occur relative to earlier stages and males captured at the same times. At this point, the data suggest that yellowtail rockfish conform to the general pattern of lecithotrophy, but may have inputs of structural lipids to embryos. The dynamics of and influences on maternal-embryonic nutrition will be further clarified during the next few reproductive cycles, when increased frequency of field sampling and laboratory experiments will be conducted on pregnant females. (R. B. MacFarlane, FTS 556-0565)

Study on Chromatophoroma Occurrence and Prevalence

Chromatophoromas (pigment hyperplasia) have been observed on various species of rockfish. NOAA Junior Fellow Penny Ruvelas has undertaken a study of the occurrence and prevalence. This work is described in a progress report based on data from approximately 200 fish of various species sampled at the Tides Dock, Bodega Bay, and captured near Cordell Bank and Pigeon Point, California. At the beginning of this study, pigment spots had been observed in five species of rockfish: yellowtail (*S. flavidus*), bocaccio (*S. paucispinis*), olive (*S. serranoides*), widow (*S. entomelas*), and chilipepper (*S. goodei*) (Okihiro et al., MS, in preparation).

Interestingly enough, the latest port sampling has turned up three new species with pigment spots: blackgill (*S. melanostomus*), stripetail (*S. saxicola*), and aurora (*S. aurora*). Another new occurrence was the observation of a raised neoplastic tumor on a large boccaccio (female, 625 mm). Of the 12 specimens in the overall sample with pigment spots, 9 were female and 3 were male. The overall sample contained more females, having a total of 152 females to 43 males - a 3.5:1 ratio. This ratio coincides with the female:male sample pigment spot incidence ratio of 3:1. Further research on occurrence and prevalence of chromatophoromas will be conducted on the upcoming *David Starr Jordan* cruise. During this cruise, tissues from pigmented specimens will be sampled for analysis with light and electron microscopy. (P. Ruvelas, FTS 556-0565)

INFORMATION TECHNOLOGY SERVICES

The National Data Management Committee Meets in Seattle

The National Data Management Committee (NDMC) meets two or three times yearly to discuss national and regional ADP-type issues. Members of the committee are representatives from the NMFS Headquarter's Data Management Division and the Regional Data Base Administrators from the field.

On August 20, the NDMC met in Seattle, WA at the Alaska Fisheries Science Center for two days and at the Northwest Fisheries Science Center for one day. Attending the meetings were committee members Michael Fraser and James Sargent (HQ), Eugene Heyerdahl (NE), MaryAnne Treadway (SE), Dorothy Roll (SW), and chairperson Ted Rodgers (AK). The other participants from HQ were Mark Holliday, Chief, Statistics Division, and Craig Felber, Office Automation Manager in the Management Services Division.

The specific agenda items were the IT-95 status, data management and technology planning, data management standards, and security issues. The following is a recap of the information/key actions related to two topics of immediate concern to the Center staff. (D. Roll, FTS 893-7057)

IT-95 Status

Amendment 15 to the IT-95 Request for Proposal (RFP) was targeted for release at the end of August. Amendments, in response to the vendors' requests for clarification of the specifications, should minimize the possibility of protests upon award to the winning vendor. The estimated closing date for the technical proposals is October 15, 1991.

With responsibilities as members of the Source Selection Advisory Board (SSAB), the RDBA's were given the Technical Scoresheet to review and comment. The scoresheet was developed by Benchmark Team members, who also serve as the Technical Advisory Committee (TAC). The TAC will score the desirable features proposed by the vendors according to the Technical Scoresheet.

In preparation for the IT-95 systems and prior to the selection of the winning vendor, all sites targeted for a system must develop a software conversion plan. Each site will be asked to inventory their database systems, review the related application software, and prioritize the software for conversion. (D. Roll, FTS 893-7057)

Security Issues

The Computer Security Act of 1987 requires all Federal Agencies to implement a plan for the security and privacy of computer systems. The objective of the security planning process is to reduce the risk and magnitude of disaster resulting from the loss, misuse, or unauthorized access to or modification of data in Federal computer systems.

The Department of Commerce (DOC) has determined that the computer security plans submitted in previous years require major modifications. In addition, the plan format has changed significantly. All system plans must be redone in line with the new requirements and format. These plans will be considered living documents to be reviewed and updated on an annual basis.

Security plans are required for major applications and for general support systems. The outline format differs for the two types of systems. Guidance is forthcoming from NMFS HQ to assist the field staff in completing the security plans by November.

The last order of business before the meeting adjourned was the nomination and appointment of Dorothy Roll to serve as the NDMC Chair during FY-1992. (D. Roll, FTS 893-7057)

PUBLICATIONS

Published

Balazs, G. H., R. Fujioka, and C. Fujioka. 1990. Some aspects of the green turtle fecal wash-up phenomenon on Hawaiian beaches, pp. 149-152. *In*: T. H. Richardson, J. I. Richardson, and M. Donnelly (compilers), Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SEFC-278.

Balazs, G. H., E. D. Gomez, and N. B. Linsley. 1990. Marine turtle postage stamps of the world--promoting conservation, pp. 215-219. *In*: T. H. Richardson, J. I. Richardson, and M. Donnelly (compilers), Proceedings of the Tenth Annual Workshop on Sea Turtle Biology and Conservation. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SEFC-278.

Boehlert, G. W. 1991. Southwest Fisheries Science Center Honolulu Laboratory, pp. 147-148. *In*: C. D. Becker (ed.), Fisheries Laboratories of North America. Am. Fish. Soc., Bethesda, MD.

Bushnell, P. G., and R. W. Brill. 1991. Responses of swimming skipjack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*) tunas to acute hypoxia, and a model of their cardiorespiratory function. Physiol. Zool. 64(3):787-811.

Heart rate and swimming-speed responses to acute hypoxia were measured in skipjack (*Katsuwonus pelamis*) and yellowfin tunas (*Thunnus albacares*). Swimming speeds began to increase in both species

when O_2 tension (PO_2) reached approximately 124 mm Hg. Bradycardia became significant in both species when PO_2 reached approximately 130 mm Hg. Heart rate fell with PO_2 in yellowfin tuna, but, in skipjack tuna, it increased at the lowest O_2 levels reached (89-70 mm Hg). Bradycardia occurred in both species despite concomitant increases in swimming speed. A continuous infusion dye dilution was used to monitor change in ventilation volume ($\dot{V}_g$) during hypoxia in yellowfin tuna. As PO_2 fell, $\dot{V}_g$ increased. At the lowest O_2 levels (109-90 mm Hg), $\dot{V}_g$ was 45% higher than during normoxia. Ventilation volume increased despite no concomitant increases in swimming speed. Data from the experiments were used to develop a model capable of predicting O_2 demand and delivery, maximum sustainable (i.e., aerobic) swimming speeds, and minimum survivable O_2 levels for yellowfin and skipjack tunas. Results from the model indicate that the cardiorespiratory system of tunas is capable of maximum rates of O_2 delivery, even at low swimming speeds, that are approximately three times those of other active teleosts. We believe that, because of the pelagic environment provides no place to hide and rest following exhaustive activity, the ability of the cardiorespiratory system of tunas to deliver O_2 to the tissues at high rates evolved for the rapid repayment of O_2 debts rather than to permit exceptionally high sustained swimming speeds.

Edwards, Elizabeth F. and Pierre M. Kleiber. 1991. CHARTOPS: Simulating short-term use of the tuna purse seine fleet to survey dolphin schools in the eastern tropical Pacific Ocean. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-163, 22 p.

Matsui, Tetsuo, Susumu Kato, and Susan E. Smith. 1990. Biology and potential use of Pacific grenadier, *Coryphaenoides acrolepis*, off California. Mar. Fish. Rev. 52(3):1-17.

This report deals primarily with aspects that pertain to the harvest and utilization of the Pacific grenadier, *Coryphaenoides acrolepis*, providing information on fishing methods, catch rates, distribution, and qualities of its flesh. Information on its biology is also included as well as data on giant grenadier, *Albatrossia pectoralis*, and sablefish, *Anoplopoma fimbria*, which are often caught together with Pacific grenadier.

McBride, Anne and Joseph e. Hightower. 1991. Predicting sablefish age using otolith characteristics. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFSC-162, 15 p.

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